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COPIOUS WATER-DRINKING AND POLYURIA IN TYPHOID FEVER. A CONTRIBUTION TO TREATMENT.

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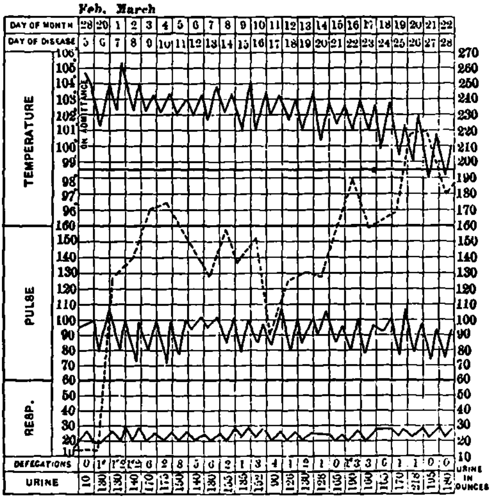
During the summer months of 1903, when, typhoid fever being unusually prevalent in Cleveland, the wards of the Lakeside Hospital contained many cases of this disease, an attempt was made, at first in the female ward alone, to give much larger quantities, than usual, of water to drink to the fever patients, to determine its effects on their comfort and condition. The free use of water internally is, of course, accepted as important in the treatment of typhoid fever; and it has been the custom in the hospital to see that a patient with this disease should have what was thought an abundant supply. In the nursing directions, three pints daily has been set as the least amount which such a patient should receive; and besides the water given by the nurse, a quart bowlful of ice-water with a bent-glass tube on a stand by the bed-side has enabled the individual to help himself with a minimum of exertion. The twenty-four-hour amount of urine, always measured and charted, has shown in most cases a daily record of from forty to fifty ounces during the time of the fever, and this has been taken as a fair index of sufficient fluid ingestion.

In trying to administer additional water it was soon found, with the efficient help of an admirable head-nurse, that without discomfort or special reluctance on the part of most patients, the unexpected and unusual amounts of from a gallon to a gallon and a half, or even more, could easily be taken. This was accomplished by giving four ounces of water every fifteen minutes during the waking hours, amounting to from eight to fourteen pints, according to circumstances, in the twenty-four hours. In addition the ordinary patient received every two hours during the day, and once or twice at night, alternately six ounces of milk and six ounces of albumen-water, representing some three pints more of fluid. These large quantities, so given, were well borne. An occasional patient rebelled at first at the frequent dosage, but most took the water readily and some greedily, and the reluctant were, as a rule, soon persuaded that their comfort was enhanced thereby. The resulting diuresis was marked. The amount of urine passed in the twenty-four hours after admission in the average case was found to be about twenty ounces. After forty-eight hours, or by the end of the third day, with much uniformity in the abrupt response to the copious water-drinking, as the charts show, there resulted a daily elimination of from eight to twelve pints, and even in some cases two gallons or more of urine; and the polyuria was readily kept near this level in an uncomplicated case during the febrile part of the illness. A daily urine flow of from 120 to 160 ounces was established and maintained with ease in the average case (Chart I.); 220 ounces and more were not unusual (Charts II. and III.), and in an occasional instance, like that of Annie M., Medical No. 3720 (Chart IV.), ten ounces were passed on the day of admission, to be succeeded on the third day by the enormous flow of 431 ounces, while the average elimination was 270 ounces.

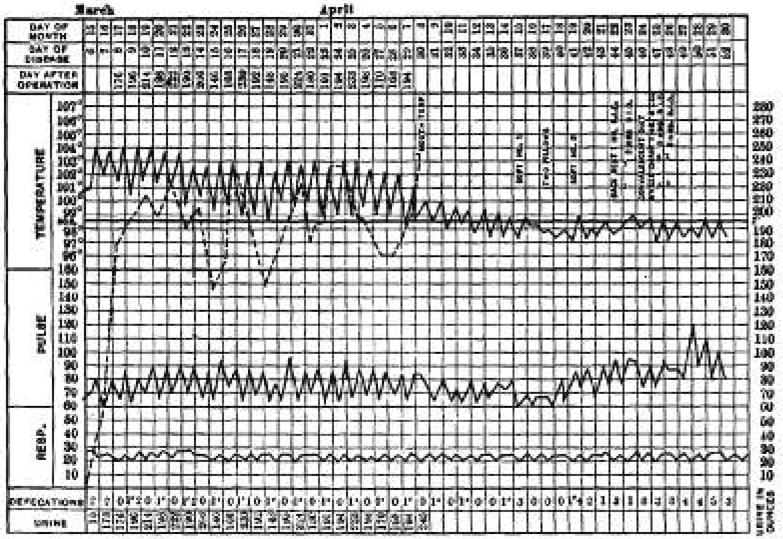
CHART I.



V., Med. No. 4231. The broken line shows the urine in ounces.

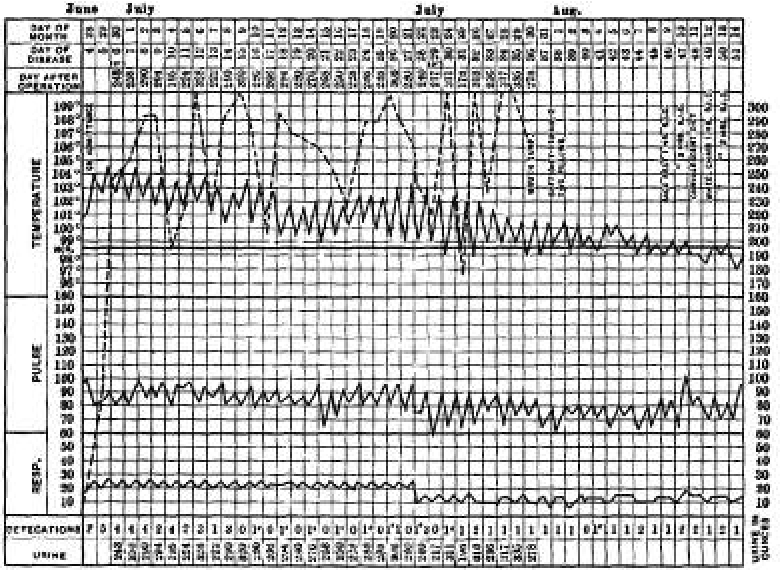
The daily number of typhoid fever cases in the hospital at this time was from forty to fifty, and the nursing-staff was taxed to the utmost with the routine care of the patients, and especially with the great number of tub-baths required. In the ward, however, where this experiment in hydrotherapy was undertaken, the head-

CHART II.



D., Med. No. 4063. The broken line shows the urine in ounces. The record was omitted when the temperature became normal.

CHART III.



K., Med. No. 4266. Abrupt rise in the urine from 10 ounces on the first day to 243 ounces on the second day; maximum, 328 ounces on the ninth day.

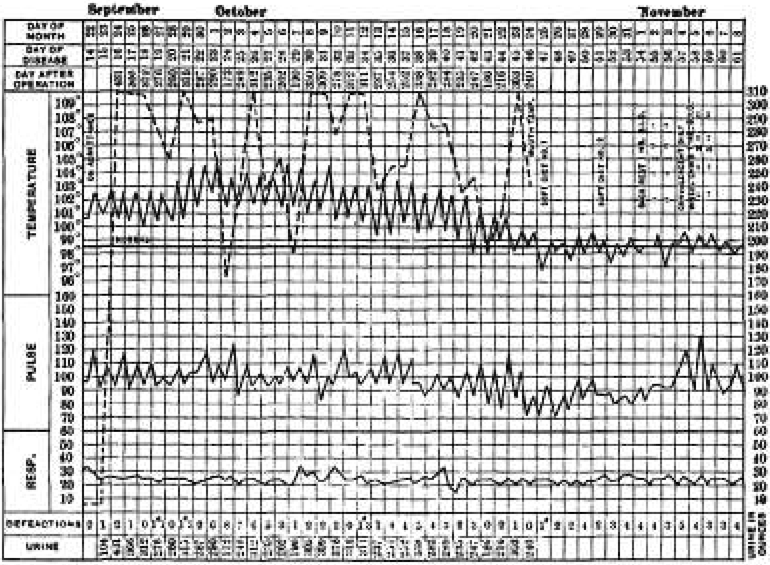
nurse was soon decided in her judgment that fewer baths were needed and that the total nursing care of the typhoid patients was less, in spite of the extra attention which the frequent administration of water and the increased use of urinals involved. In the bedside observation of this group of cases, the general comfort of the patients so treated seemed apparent. Headaches were not so troublesome, so that the familiar ice-bag was much less in evidence in the ward. Tongues and mouths kept noticeably clean and moist, and the toilet of the mouth cavity was a much simpler nursing task. Apathy, deafness, restlessness, nocturnal delirium and other nervous and toxæmic symptoms seemed less in evidence, hypnotics were not so often needed, nausea was unusual, and remissions in temperature appeared more frequent. Complications, minor and major, were few among the patients, and there were no deaths in this first small series, amounting to twenty cases, though the prevailing epidemic was of severe type, and the general mortality in the community and in the other wards of the hospital at the same time was large.

An additional year's experience, during which this element of treatment has been continued with more or less thoroughness in all the medical wards of the hospital and in the services of Dr. H. H. Powell, Dr. J. H. Lowman, and Dr. H. S. Upson (I am greatly indebted to these gentlemen for permission to utilize their cases), as well as of the writer, has seemed to confirm the early impression of its usefulness, and demonstrated that in all cases of typhoid fever, unless on admission profoundly toxic or with serious complications, or in the case of children who will not, as a rule, take water so often, this very abundant flow of urine can be secured with certainty in forty-eight hours and kept up during the illness. The method of administration first adopted of having the patient receive, when awake, four ounces of water every quarter of an hour, has been continued. Larger quantities at a time are less acceptable, and often not well tolerated, while small amounts, frequently given, are usually not unwelcome.

The urine in these cases when the daily amount exceeds a gallon, is extremely pale, with a specific gravity of from 1001 to 1005. With an elimination of more than 200 ounces, the specific gravity of the watery fluid is often below 1001. There was found to be a close approximation in the absence of diarrhœa or sweating, between the amount of fluid ingested and the quantity of urine eliminated. Thus in the case of K. (Chart III.), during ten days, 2664 ounces of fluid were given, while the quantity of urine passed was 2626 ounces, an average daily difference of some four ounces. On certain days the amount of urine passed would slightly exceed the liquid taken. When obvious perspiration was present, or several loose movements occurred, the disproportion was, of course, more marked.

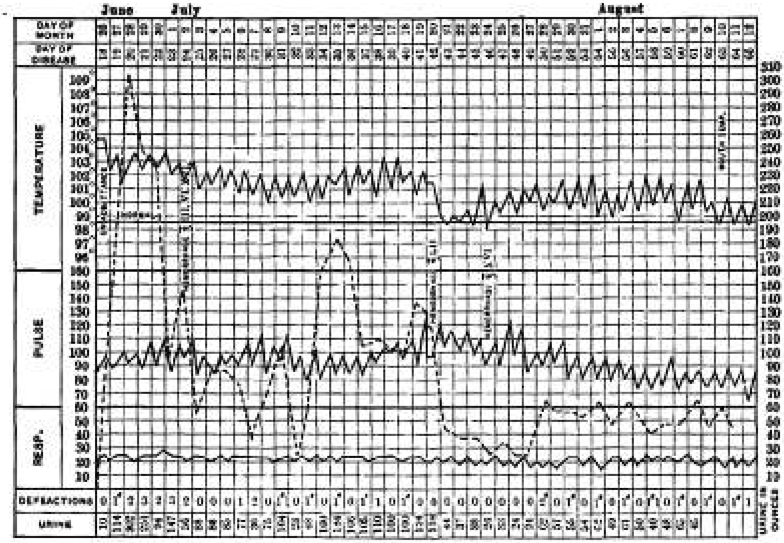
In the case of B., Medical No. 4230, where the skin kept moist during most of the illness, 1358 ounces of fluid were given in six days and 844 ounces passed, a daily average of 226 ounces and 140

CHART IV.



A. M., Hosp. No. 8720. Extreme case of polyuria, with increase of urine from 10 ounces on the first day to 431 ounces on the second day.

CHART V.



C., Med. No. 4281. Abrupt rise in urine from 10 to 302 ounces. The sudden drops in the curve mark the limitation of fluid ingestion following the intestinal hemorrhages.

ounces, respectively. Chart V. shows the effect of repeated hemorrhages upon the quantity of urine, with the subsequent stoppage of milk and restriction of water supply.

From June 1, 1903, when the treatment was begun in one of the wards, to October 1, 1904, 100 cases of typhoid fever have shown a daily urine flow of 100 ounces or more; in 56 of this number the amount has been between 100 and 160 ounces; in the other 44 cases, over 160 ounces. During this entire period of sixteen months, 308 cases have been in the hospital, but during the eight months since January 1, 1904, only 105 cases, the improvement in the Cleveland water supply having greatly lessened the frequency of the disease since April, 1904. And as it was not until February, 1904, that this method of water-giving became general in the medical wards, the 100 cases represent a more nearly consecutive series than the discrepancy in totals would indicate.

These cases have been carefully analyzed by Dr. Clarke, who, as resident physician, has had charge of most of them, as to their course, complications, and fatality, and contrasted with a series of 50 cases during the early part of the same period, in which there was no attempt to establish polyuria, and with the 373 cases in the hospital during the year 1903. The duration of *fever* in the two former sets of cases proved precisely the same, 30.7 days; and exactly 8 per cent. of *relapses* occurred in these groups with 11 per cent. in the 1903 series. The average number of tub-baths (given every four hours if the temperature reached 102.5°) in the cases of urine flow below 100 ounces was 46; of those above 100 ounces, 38.6; of the 44 cases above 160 ounces, 32, pointing to greater remissions of temperature in the polyuria cases. *Bowel movements* were apparently little affected by the large amounts of water ingested, contrary to the expectation that constipation would be less common, and the proportion of cases with regular movements, constipation or diarrhœa was practically the same in the three contrasted series. *Retention of urine* occurred in the first twenty-four hours after admission in 2 cases, and in 1 was persistently troublesome. The thin, watery urine was well tolerated by the bladder, as a rule, and eighteen or twenty ounces were often passed at a time, though with a daily elimination of one or two gallons this involves frequent urination. As much less fluid was given at night, this does not imply disturbance of rest. There were 10 cases of *hemorrhage* in the polyuria group, 8 in the 56 cases below 160 ounces, and 2 in the 44 cases with more than 160 ounces, to compare with 12 per cent. and 6.7 per cent. of the other series. No one of these 10 hemorrhage cases was fatal. One case of *perforation* occurred in the 100 cases; 3 in the group of 50, and 15, the unusual percentage 4 in the 373 cases of 1903. *Phlebitis* was met with but once. The proportion in the other groups being 6 per cent. and 3.5 per cent.; and though the frequency with which venous thrombosis occurs in typhoid varies much, it is conceivable that the copious water-drinking may lessen the tendency to the formation of agglutination thrombi. *Otitis media* was also infrequent, 3 cases developing, 3 per cent., with 3 in the 50 series, 6 per cent., and 16 in the 1903 series, 4.3 per cent.; and it seems plausible that the clean, moist mouths of these cases may well lessen the likelihood of middle-ear infection. *Meteorism,* however, usually of moderate but in some cases of considerable degree, was more common among the patients taking large quantities of water. Whether a coincidence or in any degree dependent on the treatment does not appear. The *skin* of these patients seemed less dry and harsh than usual; and *furunculosis* occurred only once or twice.

It is regretted that incompleteness of earlier records makes it impossible to compare with accuracy such symptoms as *headache, apathy, restlessness, insomnia,* and mild *delirium;* but the impression is strong in the minds of those who have cared for and watched these patients, whether nurses, house-staff, or the visiting physician, that just these toxic nervous symptoms of the disease, the symptoms so beneficially influenced by the cool-bath treatment of typhoid fever, are still more efficiently controlled by the copious water drinking, employed, of course, as an accessory, not a substitute means of hydrotherapy, and that patients are more comfortable for the treatment.

The total *mortality* of the polyuria group of 100 cases was five, 5 per cent. Four deaths occurred among the 54 cases with an elimination below 160 ounces, 1 death in the group of 46 cases where 160 ounces were exceeded. The latter case, after a severe illness, but when apparently convalescing satisfactorily, died on the sixth day of normal evening temperature, with an acute dilatation of the right heart. The other four fatalities were due, one to toxæmia one to perforation, one to laryngeal perichondritis, and one to peritonitis following an operation for suspected perforation. The mortality of the 308 cases in the hospital during the period under consideration from June, 1903, to October, 1904, and including the 100 polyuria cases, was 7.8 per cent., with twenty-four deaths. The mortality of the year 1903 was, however, usually large, 10.2 per cent. of a total of 373 cases, and the last half of this year with its large quota of patients not having such quantities of water internally, contributes two-thirds to the entire group of 308 cases. The death rate of the 105 patients discharged from the hospital during the eight months from January 1 to October 1, 1904, has been 6.6 per cent.

From March 1st to October 1st, the period during which all patients, with few exceptions, have received this form of treatment, there have been 77 cases with 3 deaths, 3.9 per cent, and, to date (October 11th) 86 cases with a mortality of 3.4 per cent. Finally, from April 1, 1904, to October 11, 1904, the rather unusual consecutive series of 56 cases without a death has occurred.

		Days of fever.	Highest temperature.	Number of baths.	Condition of bowels.						Complications.												Mortality.									
					Constipation.		Regular.		Diarrhœa.		Relapse.		Hemorrhage.		Perforation.		Otitis media.		Phlebitis.		Meteorism.		Total mortality.		Toxæmia.		Pneumonia.		Perforation.		Rare causes.	
					No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
Below 100 ounces.	50 cases.	30.7	104.5	46	19	38	23	46	4	8	4	8	6	12	3	6	3	6	3	6	7	14	6	12	1	2	2	4	3	6	0	0
Above 100 ounces. (Polyuria series.)	100 to 160 56 cases.	31.5	104.4	44	23	43	20	36	10	18	5	9	8	14	1	2	2	4	0	0	14	25	4	7.2	1	2	0	0	1	2	2	4
	Over 160 44 cases.	29.6	104.2	32	28	58	15	34	4	9	3	7	2	4	0	0	1	2	1	2	17	39	1	2	0	0	0	0	0	0	1	2
	Total 100 cases.	30.7	104.3	38.6	46	46	35	35	14	14	8	8	10	10	1	1	3	3	1	1	31	31	5	5	1	1	0	0	1	1	3	3
All cases, 1903.	373 cases.	......	......	......	...	...	...	...	...	...	40	11	25	6.7	15	4	16	4.3	13	3.5	...	...	38	10.2	13	35	5	1.3	14	3.7	6	1.6

As the 100 cases of typhoid fever with polyuria reported represent, in some measure, a selected group, the small and diminishing mortality rate is, of course, at the most, suggestive. It is felt, however, that certain conclusions as to the results and usefulness of this mode of treatment, which seems to supply an additional means of combating the toxæmia of the disease, may be submitted with some confidence with the hope that this method of copious water-drinking with its resulting diuresis, may be found by other observers to diminish in some further degree the severity and mortality of typhoid fever in hospital practice.

Our experience and conclusions may be summarized as follows:

1. Large quantities of water internally, a gallon or more in twenty-four hours, may easily be taken by typhoid fever patients, if administered in small quantities at frequent and definite intervals.
2. A copious elimination of watery urine at once follows, the degree of polyuria, day by day, closely corresponding to the quantity of fluid ingested.
3. Patients are more comfortable by this mode of treatment and toxic, nervous symptoms are lessened.
4. The mortality, as well as the severity, of typhoid fever, seems to be still further diminished by this method of hydrotherapy employed as an accessory to the cool-bath treatment of the disease.

CHLORIDE AND WATER EXCRETION IN TYPHOID FEVER, WITH COPIOUS DIURESIS.

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I. INTRODUCTORY.

The clinical tests of Drs. Cushing and Clarke, described in the preceding paper, offered an opportunity of investigating several interesting features of urine secretion in typhoid fever, as influenced by unusually large diuresis, the consequence of a very free administration of water. This opportunity we were glad to utilize as far as time would permit. To avoid complications, we confined ourselves to the study of the excretion of water and chlorine, neglecting all the other urinary constituents.. The practical agreement of the results in all the cases examined shows that the material was sufficient to justify general conclusions.